MCAA
AsiaConnect
2024

Book of Abstracts

Edited by **Eugenio H. Otal** and **Vishwas Lakkundi**

MARIE CURIE ALUMNI

Please cite this work as:
E. H. Otal and V. Lakkundi (2024) (Eds). *MCAA AsiaConnect 2024: Book of Abstracts*. Brussels: Marie Curie Alumni Association.

Editors
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Brussels: Marie Curie Alumni Association
doi: https://doi.org/10.56647/DDNA5724
PDF ISBN: 9789464336092 **KBR**: D/2024/15498/03

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This publication features presentations from the MCAA AsiaConnect 2024 event, held in two online sessions: "Advancing Environmental Science" (16 November 2024) and "Innovations in Computer Science and AI" (30 November 2024). The event was jointly organised by the MCAA India Chapter, the MCAA Japan Chapter, the MCAA China Chapter, the MCAA Argentina Chapter, and the MCAA Research Funding Working Group.

The recordings are available on the YouTube channel of the MCAA:

- Advancing Environmental Science
  https://youtu.be/kAuIts85ho4?si=-GjBAnTaiiFqWOv4
- Innovations in Computer Science and AI
  https://youtu.be/V-iqY9Du3Mg?si=V2snrUD2K-EVGP_5

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Introduction

This Book of Abstracts reflects the core mission of the Marie Curie Alumni Association (MCAA): to unify the Marie Skłodowska-Curie Actions community, support researchers at every career stage, and serve as a collective voice for scholars across all regions and disciplines.

In Asia a region defined by the convergence of vast scientific capacity, economic dynamism, and shared societal challenges—science diplomacy is far more than a complement to research; it is one of its most vital expressions. UNESCO defines science diplomacy as the use of scientific knowledge and collaboration to strengthen international relations and address global challenges. In that spirit, **MCAA AsiaConnect** affirms a fundamental principle: trust flourishes where cooperation is sustained.

Just as the free exchange of commerce is said to prevent conflict, the free exchange of ideas ensures that societies benefit from the practical advances that improve daily life. Research partnerships are more than technical endeavors; they are instruments of peace and understanding. By working across borders, we demonstrate that when knowledge is shared, the barriers that once seemed immovable begin to dissolve, paving the way for a future defined by common achievement rather than division.

Advancing Environmental Science

The Benefits of Taichi Lifestyle: The Harmony of Environment and Health

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Abstract: The Taichi lifestyle presents a holistic approach to health that harmonizes body, mind, and environment, offering a counterbalance to the adverse effects of modern living. Rooted in Daoist philosophy, the lifestyle emphasizes principles of dynamic balance, Yin and Yang harmony, and a mindful connection with nature. With increasing urbanization and environmental challenges, many individuals face high stress, sedentary habits, and diminished mental and physical health. This article explores the Taichi lifestyle's structure, principles, and potential health benefits as a response to these challenges. Integrating dietary balance, physical activity, social engagement, and environmental awareness, the Taichi lifestyle embodies a sustainable path for cultivating resilience and well-being.

Research Area: Earth Science and Sustainability

3D Palladium Nanostructures Immobilized in Polymer Matrices for Catalysis

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Abstract: This research focuses on synthesizing 3D palladium nanostructures immobilized within polymer matrices, designed to enhance catalytic efficiency for industrial applications. By manipulating structure and composition at the nanoscale, the study provides insights into optimizing catalytic activity while ensuring environmental sustainability.

Research Area: Environmental Chemistry and Contamination

References

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U.S. Markad, A.M. Kalekar, D.B. Naik, K.K.K. Sharma, K.J. Kshirasagar, G.K. Sharma, Photo enhanced detoxification of chromium (VI) by formic acid using 3D palladium nanocatalyst, J. Photochem. Photobiol. A Chem., 2017 (338), 115-122

Metal-Organic Frameworks for Fluoride Detection in Drinking Water.

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Abstract: Over the past years, I have focused on implementing metal-organic frameworks (MOFs) for fluoride detection in drinking water, focusing on portable and cost-effective water quality sensors. Specifically, this study explores the use of UiO-66 and Al-BDC MOFs with defect engineering and rhodamine B modification for highly sensitive fluoride detection. These findings have significant implications for water provision solutions in rural areas and open the gates for new approaches in the development of portable water sensors.

Research Area: Environmental Chemistry and Contamination

References

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The Environmental Footprint of Printing and Ink Production

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Abstract: The printing and ink industries have a substantial environmental impact, primarily through emissions, resource consumption, and waste generation. This research investigates sustainable production methods and alternative materials that reduce the environmental footprint of these industries, aiming to achieve a balance between industrial needs and ecological preservation.

Research Area: Earth Science and Sustainability

References

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Emissions of Persistent Toxic Substances in Industrial Processes

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Abstract: Polyhalogenated carbazoles (PHCZs) and rare earth elements are persistent toxic substances emitted in various industrial processes. This study examines their sources, pathways, and environmental impact, highlighting the need for strategies to control emissions and mitigate long-term ecological damage.

Research Area: Environmental Chemistry and Contamination

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Dynamics of Microbial Networks in Activated Sludge for Wastewater Treatment

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Abstract: Activated sludge (AS) is widely used for wastewater treatment. This research delves into the microbial network dynamics within AS systems, identifying key microorganisms that contribute to efficient organic matter breakdown and pollutant removal.

Research Area: Water Management and Conservation

References

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Goods and Bads in International Trade: A New Approach

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Abstract: This paper expands the scope of traditional trade theories by examining both the beneficial and detrimental environmental effects of international trade. The study proposes a framework for assessing environmental impact in trade policies to foster sustainable development.

Research Area: Earth Science and Sustainability

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Barter Mode: Institutional Innovation for Sustainable Development

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Abstract: In response to the environmental costs of mass production, this study explores the barter mode as an institutional innovation that encourages resource efficiency and waste reduction. Case studies highlight its applications in promoting sustainable consumption.

Research Area: Earth Science and Sustainability

References

Shu Wang, Changbin Yin, Xiaomei Yang, Aurore Richel, 2023. Barter mode: The institutional innovation for affordable and clean energy (SDG7) in rural China. Biomass and Bioenergy 170, 106725.

Mine Water Chemistry and its Utilization for Environmental Management

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Abstract: Freshwater scarcity and contamination are major environmental concerns. This research focuses on utilizing mine water chemistry to address these issues, aiming to develop sustainable solutions for contaminated water in mining areas. Specific methodologies and results obtained from sample analyses are discussed, offering innovative applications for mine water management in eco-friendly ways.

Research Area: Environmental Chemistry and Contamination

References

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Innovations in Computer Science and AI



The Role of Surface Steric Effects in Boosting Catalytic Activity via Strong Metal-Support Interactions

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Abstract: Strong metal-support interactions (SMSI) in supported nanoparticles hold remarkable promise for enhancing catalytic activity. However, the atomistic foundations of SMSI remain incompletely understood, partly due to limitations in current computational methods. In this study, we investigate the atomistic mechanisms of SMSI in N_2 dissociation on Ru/La{0.5}Ce{0.5}O{1.75-x} catalysts. Employing a novel neural network potential, we analyzed 200 complex nanoparticle models with diverse site heterogeneities, comprising over 15,600 adsorption sites. Through rigorous validation against experimental IR spectra, we discovered that N_2 molecules located between decoration cations on nanoparticles near the support exhibited a notably low activation barrier for dissociation. Our findings bridge the gap between simulation and experimental data and deepen our understanding of complex supported nanoparticle catalysts.

Research Area: Advanced Computing and AI Hardware (Quantum Computing and Quantum Machine Learning)

References

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Overview of AI Governance in Industry: Frameworks, Challenges, and Pathways Forward

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Abstract: As artificial intelligence (AI) becomes increasingly integrated into business operations, products, and services, effective AI governance has emerged as a critical priority for organizations worldwide. This talk provides an overview of AI governance in the industry, exploring key frameworks, regulatory landscapes, and ethical considerations that shape how companies implement and manage AI technologies. We will examine core components of AI governance, including transparency, accountability, bias mitigation, data privacy, and risk management, and review leading industry standards and best practices that guide responsible AI deployment. Additionally, the presentation will discuss challenges such as regulatory inconsistencies, stakeholder alignment, and operationalizing ethical principles. Case studies from diverse sectors illustrate how companies can balance innovation with ethical considerations, ensuring AI systems align with organizational values and societal expectations.

Research Area: Privacy, Ethics, and Governance in AI

References

Floridi, L., and Cowls, J. (2019). A Unified Framework of Five Principles for AI in Society. Harvard Data Science Review. This framework provides a foundation for understanding the ethical implications of AI and is a basis for examining how companies can align AI practices with governance goals.

AI at Mercari

Norbert Preining

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Abstract: Mercari is the biggest consumer-to-consumer in Japan, and the first unicorn in Japan. With a gross merchandise value of about 6.7 billion USD (FY2022), over 20 million monthly active users, and 100s of millions of active listings in catalog, Mercari is hosting a huge trove of data.

We use cutting edge AI for a variety of purposes across the Mercari group, from search, recommendation, LLM models for automatic listings, just to name a few. Developing new technologies and AI based application, as well as carrying many projects to full product stage, Mercari provides ample opportunities for researchers, practitioners, and developers. Researching, working, and developing in such an environment is both highly challenging and greatly rewardful.

In this short presentation we will give a short overview of typical usage of AI at Mercari and the stringent conditions under which our AI has to work in the full product setting, and also the direct impact AI has on Mercari's products and business KPIs.

Research Area: AI Applications in Specific Domains (Healthcare, Education and Personalized Learning, Sustainable Development and Climate Change, Creative Arts)

Predicting redox potentials by graph-based machine learning methods

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Abstract: The evaluation of oxidation and reduction potentials is a pivotal task in various chemical fields. However, their accurate prediction by theoretical computations, which is a complementary task and sometimes the only alternative to experimental measurement, may be often resource-intensive and time-consuming. This research addresses this challenge through the application of machine learning techniques, with a particular focus on graph-based methods (such as graph edit distances, graph kernels, and graph neural networks) that are reviewed to enlighten their deep links with theoretical chemistry. To this aim, we establish the ORedOx159 database, a comprehensive, homogeneous (with reference values stemming from density functional theory calculations), and reliable resource containing 318 one-electron reduction and oxidation reactions and featuring 159 large organic compounds. Subsequently, we provide an instructive overview of the good practice in machine learning and of commonly utilized machine learning models. We then assess their predictive performances on the ORedOx159 dataset through extensive analyses. Our simulations using descriptors that are computed in an almost instantaneous way result in a notable improvement in prediction accuracy, with mean absolute error (MAE) values equal to 5.6 kcal/mol for reduction and 7.2 kcal/mol for oxidation potentials, which paves a way toward efficient in silico design of new electrochemical systems.

Research Area: AI Applications in Specific Domains (Healthcare, Education and Personalized Learning, Sustainable Development and Climate Change, Creative Arts)

References

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AI for Intelligent Space Management

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Abstract: In today's rapidly evolving corporate workplaces, the need for efficient and dynamic space management solutions has never been greater. Traditional space planning methods, once the backbone of office organization, now benefit from the support of AI-driven Space Management Solutions. SpaceOnAi, a leading tool by Smarten Spaces, offers a transformative approach that greatly assists Corporate Real Estate (CRE) professionals in optimizing corporate workplaces, accurately. This talk explores the advantages and limitations of both approaches, backed by credible data and industry insights.

Research Area: AI Applications in Specific Domains (Healthcare, Education and Personalized Learning, Sustainable Development and Climate Change, Creative Arts)

References

[1] www.smartenspaces.com

[2] www.spaceonai.com

GraphRAG: Redefining AI with Smarter Connections and Contextual Understanding

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Abstract: In this talk, the author will share the what, why, and how of GraphRAG (Graph Retrieval-Augmented Generation), an innovative approach that combines graph-based knowledge representation with retrieval-augmented generation techniques to revolutionize natural language processing (NLP). GraphRAG is a method where data is represented as a graph, nodes for entities and edges for relationships, allowing AI to retrieve interconnected information and generate insightful, contextually accurate outputs. Unlike traditional retrieval methods that rely on unstructured text, GraphRAG can trace complex relationships, enabling advanced reasoning and deeper understanding.

Current systems struggle with tasks requiring relational reasoning, such as answering multi-step queries or summarizing linked ideas. GraphRAG addresses this by leveraging graph structures, making it indispensable in applications like knowledge management, scientific discovery, and conversational AI. It is particularly effective in scenarios where both accuracy and context are critical.

By combining the structured retrieval of graphs with the flexibility of generative AI, GraphRAG retrieves relevant nodes and relationships, processes the information, and generates coherent responses. The author will illustrate this with real-world examples, such as how GraphRAG can connect historical events, research findings, or customer support queries to deliver enriched results.

GraphRAG not only improves performance but also opens new avenues

for making AI smarter, more context-aware, and capable of handling complex, interconnected data. This talk will explore the principles, applications, and future potential of this cutting-edge approach.

Research Area: AI Theory, Models, and Learning Techniques (AGI, XAI, GNN, etc)

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Asset Selection and Optimisation for Robotic Assembly Cell Reconfiguration

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Abstract: With the rise of Industry 4.0, the manufacturing industry has embraced customisation and agility, driven by innovative technologies like reconfigurable manufacturing systems. These systems leverage robotics to adapt rapidly to market demands, providing the precision and flexibility essential for customisation. However, challenges arise in integrating diverse data sources, meeting dynamic process requirements, and optimising layouts to enhance efficiency. This report presents an AI-driven framework to address these challenges, encompassing three key components: an experience databank, a methodology for asset selection, and a layout optimisation approach.

The experience databank uses a vendor-neutral ontology model to organise heterogeneous manufacturing data into a structured knowledge graph, enabling better decision-making. The asset selection methodology employs AI to evaluate manufacturing assets against criteria like cost, energy efficiency, and manoeuvrability, ensuring adaptability to shifting requirements. The layout optimisation methodology integrates simulation and AI algorithms to improve efficiency after reconfiguration.

Validation across three use cases demonstrated significant improvements: a 15.6% cycle time reduction, 8.9% energy savings, and enhanced robot manoeuvrability by 140.8%. Additionally, multi-objective optimisation algorithms proved effective in cost-efficient asset selection. This report highlights the transformative potential of AI

in reconfigurable robotic systems, addressing industry challenges and advancing modern manufacturing.

Research Area: AI in Autonomous Systems and Robotics (IoT, Cybersecurity, etc.)

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F. Mo, H. U. Rehman, F. M. Monetti, J. C. Chaplin, D. Sanderson, A. Popov, A. Maffei, and S. Ratchev, "A framework for manufacturing system reconfiguration and optimisation utilising digital twins and modular artificial intelligence," Robotics and Computer-Integrated Manufacturing, vol. 82, p. 102524, Aug. 2023. [Online]. Available: https://doi.org/10.1016/j.rcim.2022.102524.

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Illumination reliability mask based algorithm for complex low-light image enhancement

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Abstract: Regional overexposure, regional staining and overall noise addition are the main problems bothering state-of-the-art low-light image enhancement algorithms when they are applied to complex low-light scenarios with local strong light source and local colored light source. In this paper, we propose an novel pixel wise "S-shaped" illumination reliability mask curve based mask strategy to tackle the difficulty of inconsistent illumination in complex low-light image enhancement. Further more, a deep neural network consists of three modules of illumination estimation, illumination reliability mask and low-light image enhancement is completed to implement the mentioned strategy. Extensive experiments certified that our proposed approach outperforms state-of-the-arts methods under NIQE, SSIM metrics on datasets MEF, LIME, DICM, VV and all of them.

Research Area: AI in Autonomous Systems and Robotics (IoT, Cybersecurity, etc.)

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Deep Leaning Based MRI Reconstruction

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Abstract: One challenge of chemical exchange saturation transfer (CEST) magnetic resonance imaging (MRI) is the long scan time due to multiple acquisitions of images at different saturation frequency offsets. k-space under-sampling strategy is commonly used to accelerate MRI acquisition, while this could introduce artifacts and reduce signal-to-noise ratio (SNR). To accelerate CEST-MRI acquisition while maintaining suitable image quality, we proposed an attention-based multioffset deep learning reconstruction network (AMO-CEST) with a multiple radial k-space sampling strategy for CEST-MRI. The AMO-CEST also contains dilated convolution to enlarge the receptive field and data consistency module to preserve the sampled k-space data. We evaluated the proposed method on a mouse brain dataset containing 5760 CEST images acquired at a pre-clinical 3T MRI scanner.

Research Area: AI Applications in Specific-Domains (Healthcare, Education, and Personalized Learning, Sustainable Development and Climate Change, Creative Arts.)

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DOI: https://doi.org/10.56647/DDNA5724

